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Janning et al.

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(54) **METHOD AND APPARATUS FOR TRANSMITTING A DIGITAL INFORMATION SIGNAL AND VENDING SYSTEM INCORPORATING SAME**

FOREIGN PATENT DOCUMENTS

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OTHER PUBLICATIONS

Antenna Engineering Handbook 2nd Ed., pp. 14-4 thru 14-19, publication date unknown.

"Zero Bias Silicon Schotcky Barrier Detector Diodes," *M/A-Com Semiconductor Products Operation*, pp. 2-55 through 2-58.

"Zero Bias Detector Diodes," *M/A-Com Semiconductor Products Operation*, pp. 6-93 thru 6-99, publication date known.

(List continued on next page.)

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(57) ABSTRACT

A cashless business transaction system (e.g., a vending system, a material tracking system, or a highway toll system) incorporates a method and apparatus for transmitting a digital information signal. A signal generator (311) generates a constant frequency signal. A phase modulator (305) varies the instantaneous phase of the constant frequency signal to represent digital information, thereby producing a phase modulated signal (325). A tuned resonant circuit (307) filters and averages the phase modulated signal to produce a simulated FM signal, and transmits the simulated FM signal via its antenna (309). One such business transaction system (e.g., a vending system) incorporates such a transmitter to facilitate transmission of billing information from a device located within a substantially electrically shielded environment. Another such business transaction system preferably incorporates such a transmitter to facilitate half-duplex transmission of digital information regardless of whether or not the digital information is transmitted from a device located within a substantially electrically shielded environment.

37 Claims, 14 Drawing Sheets

Microfiche Appendix Included
(1 Microfiche, 82 Pages)

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(*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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Related U.S. Application Data

(63) Continuation-in-part of application No. 08/956,732, filed on Oct. 23, 1997, now Pat. No. 6,064,308.

(60) Provisional application No. 60/060,370, filed on Sep. 29, 1997, and provisional application No. 60/029,464, filed on Oct. 25, 1996.

(51) **Int. Cl.**⁷ G06F 17/60

(52) **U.S. Cl.** 705/40; 141/94; 700/231

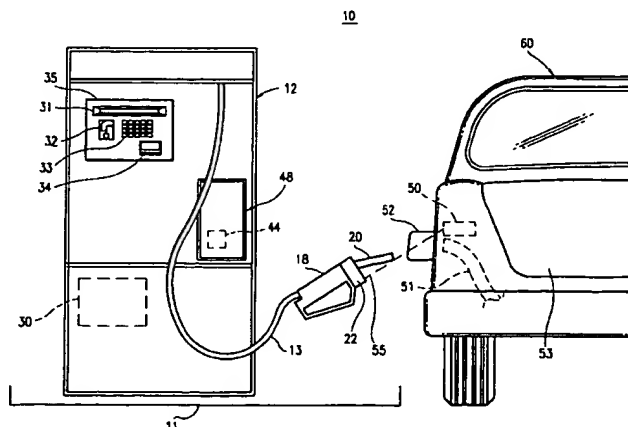
(58) **Field of Search** 700/231; 141/94; 235/381, 383; 705/40, 77, 34

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(List continued on next page.)



Examiner's
Notes

US-PAT-NO: 6446049

DOCUMENT-IDENTIFIER: US 6446049 B1

TITLE: Method and apparatus for transmitting a digital
information signal and vending system incorporating same

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Brief Summary Text - BSTX (9):

In an effort to provide an even greater degree of speed and convenience to customers, one major oil company has recently introduced another system to facilitate the vending of fuel at filling stations. This system, which typically augments rather than replaces the magnetic card reading devices already present at the pump, is presently being promoted under the trademark "**SPEEDPASS**". The "**SPEEDPASS**" system is based on radio frequency identification (RFID) technology marketed by Texas Instruments under the trademark "TIRIS." "TIRIS" technology has also reportedly been employed to track items in a variety of material handling systems and to automatically assess tolls to vehicles on toll roads without the necessity of stopping the vehicle.

Brief Summary Text - BSTX (10):

Customers interested in using the "**SPEEDPASS**" fuel vending system enroll by filling out a form that requests information identifying a credit card account to which purchases made using the system are to be posted. This credit card information is electronically encoded into a high frequency (2.45 GHz) radio frequency (RF) transponder device that is small enough to be attached to a key ring or carried in some other manner by the consumer to whom the device is issued. The fuel dispensers at participating filling stations are provided internally with a receiving unit having an antenna mounted beneath a designated area on the external surface of the dispenser. The designated area is prominently marked with identifying indicia and printed instructions for using the "**SPEEDPASS**" system. The instructions direct the consumer to bring the transponder device into proximity of the designated area. When this is done, the receiving unit within the dispenser picks up the encoded account information transmitted by the transponder device. Once the information is appropriately decoded, it is used to authorize a purchase and, at an

appropriate time (such as on completion of the dispensing operation), to post relevant information relating to the purchase (such as the amount of the purchase, the time of day the purchase was made and the like) to the corresponding account of the customer. The purchase is subsequently reflected on an invoice or billing statement provided by the credit card company or other entity.

Brief Summary Text - BSTX (11):

While systems, such as the "**SPEEDPASS**" system, may offer an incremental improvement in speed and convenience over use of a credit card, they also suffer certain drawbacks. Notably, if the transponder is lost or stolen, it can be used without authorization at any participating station. The use of off-the-shelf transponder devices may also present a security risk. Such risk may be reduced by encoding the transponder with a secondary account number that

identifies, but does not actually represent, an actual credit card or debit account number. While secondary account encoding affords additional security, such an approach limits or complicates universal acceptance of the system by vendors other than the issuer of the transponder due to the need to make available to other vendors a database cross referencing the actual and secondary account numbers. It is a disadvantage to the consumer to be limited to use of the system with only a single vendor. It is likewise undesirable to require a consumer to carry multiple transponders in order to make purchases from a corresponding multiple number of vendors.

Detailed Description Text - DETX (19):

As described above, the preferred embodiment of the present invention provides a vending system in which half-duplex transceivers associated with a product dispenser and a receptacle for the product are employed to facilitate point-of-sale billing without requiring any action by the consumer other than the consumer's normal positioning of the dispenser in or near the receptacle. By contrast, prior art fuel vending devices, such as those incorporating "**SPEEDPASS**" technology, require the consumer to carry a transponder containing

the billing information and to position the transponder near a receiver on the fuel pumping station prior to removing the dispenser from its retainer and positioning the dispenser in or near the receptacle. Thus, the present invention eliminates the need to carry yet another device containing account information which can be lost or stolen at any time. In addition, the present invention utilizes efficient half-duplex transceivers to efficiently transmit billing information from the receptacle transceiver only when requested for it by the dispenser transceiver, thereby eliminating the need for the

battery-operated receptacle transceiver to continuously transmit information and consume battery power. Still further, since only a common encryption key need be made available to other vendors, when encryption is used, the present invention can readily be implemented on a universally acceptable basis so that consumers are not limited to use of the system only for purchases from a particular vendor, in sharp contrast to prior art systems, such as the "**SPEEDPASS**" system.

Detailed Description Text - DETX (63):

The transmitting device transmits the simulated FM signal primarily via a magnetic field at a carrier frequency of about ten kilohertz or less. In the preferred embodiment, a carrier frequency of 8.192 kilohertz is used. The use of both a low frequency carrier and magnetic coupling allows the transmitting signal to escape substantially electrically shielded enclosures, such as automobile trunks, automobile hoods, or automobile fuel inlets, and provides for a fairly well constrained transmission range due to the mathematical relation that magnetic coupling decreases in proportion to the cube of the distance from the magnetic source. The transmission range of the transmitting device in the preferred embodiment remains nearly constant regardless of whether the transmitting device is transmitting from a shielded enclosure or not due to its use of magnetic coupling to convey the information. By contrast other wireless radio frequency identification (RFID) systems, such as the "**SPEEDPASS**" fuel vending system, utilize high frequency electromagnetic transmissions which have varying ranges due to their use of both electric and magnetic fields to convey a signal. In order for a transmitting device using both electric and magnetic fields to transmit from an electrically shielded enclosure, a high power transmitter must be employed to generate a magnetic field component strong enough to be detected outside the shielded enclosure. However, when such a high power transmitter is employed and the shielded enclosure is temporarily removed (e.g., when a trunk is open), the transmission range of the transmitter increases dramatically because the shielding is removed and both the electric and magnetic fields convey information. Furthermore, by using a method as described in blocks 1003-1009 to generate the signal to be transmitted, the complex circuitry typically required for FM modulation is not necessary; thus, inexpensive, small scale integrated (SSI) circuits can be used to produce the simulated FM signal.

Detailed Description Text - DETX (79):

If the billing information does not satisfy the predetermined conditions (e.g., does not indicate a valid account number and/or a valid expiration date), no product is dispensed, and the logic flow ends (1513). If the billing

information does satisfy the predetermined conditions, the vending device dispenses (1511) the product to the receptacle for the product, and the logic flow ends (1513). Therefore, as described above with respect to blocks 1501-1513, the present invention provides a half duplex system for facilitating cashless vending of products. In sharp contrast to the prior art, such as the "**SPEEDPASS**" fuel vending system, which provides for simplex operation only (i.e., only a receiver at the vending device and only a transmitter associated with the consumer for the product), the present invention provides a more secure and efficient vending system by requiring transmission of critical information, such as a consumer's credit card number, only in response to a request for such information from the vending device from which a product is desired, instead of continuous transmission of the information as in the prior art. Improved efficiency results from the use of a half duplex system because transmitters, which generally consume the largest amount of power in a transceiver, only need to operate for one short period of time responsive to a request for information.

Other Reference Publication - OREF (20):

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Other Reference Publication - OREF (21):

"Mobile **Speedpass**: how it works;"

<http://www.mobil.com/speedpass/html/technical.html> (publication date unknown--printed from the Web on Oct. 12, 1998).

Other Reference Publication - OREF (22):

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